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Hair Removal With a Non-Coherent Filtered Flashlamp Intense Pulsed Light Source

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Background and Objective: **To evaluate the effects on disruption of hair growth of the non-coherent filtered flashlamp intense pulsed light (IPL) source.**
Materials and Methods: **Twenty-eight sites on 23 patients with Fitzpatrick type I–III were enrolled using a single treatment IPL followed for three months post-treatment. Another 56 on 48 patients with Fitzpatrick skin types I–V randomly enrolled for two treatments one month apart and followed for six months.**
Study Design: **Prior to beginning treatment and at each follow-up visit hair counts were obtained by averaging three 1-cm^2 areas on a clear acetate template placed over the skin. Repeat hair counts and photographs were obtained at 2, 4, 8, and 12 weeks for the single treatment protocol and at additional 4, 5, and 6 months for the double treatment protocol. Parameters utilized were a 2.8–3.2 millisecond pulse duration typically for three pulses with thermal relaxation intervals of 20–30 milliseconds with a total fluence of 40–42 J/cm^2.**
Results: **For the double treatment protocol hair clearance of 64% was achieved immediately following the second treatment. By week 8 reduction of hair counts was 42%. At 6 months, hair counts were reduced by 33%.**
Conclusions: **Non-coherent IPL is an effective modality for long-term hair removal. IPL is safe with minimal side effects of epidermal injury or pigmentation change. Lasers Surg. Med. 24: 128–132, 1999.** **© 1999 Wiley-Liss, Inc.**

Key words: hair removal; flashlamp; pulsed light source; therapy; hypertrichosis; lasers; skin

INTRODUCTION

Public demand continues to fuel development of easier and more effective hair removal methods. For years, electrical methods of electrolysis and thermolysis have been the mainstay with as many as ten sessions required for acceptable results [1]. The desired endpoint for long-term hair removal is the destruction and fibrosis of peribulbar tissue at the base of the hair follicle [2]. Use of light energy rather than electrical energy for epilation was first reported in 1990 with the use of argon laser to treat trichiasis by "thermoablation" with a very small spot size (0.1mm) [3]. A 50% reduction of hair growth was achievable with minimal scarring on small superficial eyelid follicles [4]. The concept of a longer wavelength, 1,064 nm, to reach deep follicles was reported for the application of epilation of hair from

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RAW and MAW are preceptors for ESC/Sharplan Medical Systems.

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grafts used during urethroplasty for hypospadias repair [5]. More recently the 1,064 nm wavelength has been found useful for hair removal at extremely short pulse durations [6,7].

The application of light based technology for hair removal is based on selective photothermolysis using melanin as the target chromophore. The problem with targeting melanin, however, is that melanin resides both in the epidermis and hair follicle, yet melanin absorbs best at lower wavelengths, making deeper penetration to the base of the hair follicle more difficult. Selectivity may be achieved by targeting melanin in heavy concentrations in the hair follicle while leaving low concentrations of melanin in the epidermis unaffected [8]. This can be accomplished by homing in on larger targets with longer pulse durations while leaving smaller, less concentrated targets (epidermal melanosomes) relatively less affected [9].

Long pulsed ruby, rather than Q-switched laser pulses (694 nm, 270 microseconds, 6 mm beam diameter at fluences of 30– 60 J/cm^2) have been reported to be helpful for selective hair follicle destruction [10]. Damage was manifest by prolonged time to regrowth seen at six months in selected patients. Recent reports confirm the efficacy of the ruby laser for long-term hair destruction [11–13]. Similar findings have been reported with use of the long-pulse Alexandrite laser [14].

Selective photothermolysis for hair removal has also been applied to the filtered flashlamp intense pulsed light source (IPL) (Epilight™, ESC Medical, Yokneam, Israel), which outputs filtered non-coherent light in the 590–1,200 nm range divided in synchronized millisecond pulses separated by short thermal relaxation times for protection of epidermal melanin. The first published report of successful IPL long-term hair removal was for terminal beard hairs in two transsexual patients (male to female) [15]. Histology demonstrated atrophy of entire follicles with no scarring at the skin surface. At six months following an unusually high number of treatments (13 and 41), no pigmented or textural skin changes were observed and (by direct visual observation only) hair was virtually absent. Another recent publication indicates approximately 60% hair removal noted at 12 weeks following intense pulsed light treatment [16]. Our study was undertaken to evaluate the effects on disruption of hair growth of the non-coherent filtered flashlamp IPL in various body locations during three- and six-month intervals following treatment with either a one or two treatment protocol.

TABLE 1. Site Distribution

Anatomical location	Number of sites
Chin	10
Back	10
Bikini	6
Neck	5
Lip	5
Thigh	3
Shoulder	3
Abdomen	3
Submental	2
Forearm	2
Ear	2
Cheek	2
Preauricular	1

MATERIALS AND METHODS

Twenty-eight sites on 23 patients with Fitzpatrick type I–III were enrolled using a single treatment IPL followed for three months post-treatment. Another 56 sites on 48 patients with Fitzpatrick skin types I–V randomly enrolled for two treatments one month apart and followed for six months. Sites treated in the double treatment protocol study are listed in Table 1. Treatment sites on the face averaged 25 cm^2 whereas treatment sites on the trunk averaged 50 cm^2. Large areas were treated due to the large spot sizes of 8 × 32 mm or 10 × 45 mm delivered with each pulse.

Treatment was performed using the Epilight™ device (ESC/Sharplan Medical Systems, Needham, MA), which emits flashlamp stimulated non-coherent light filtered to limit wavelengths from 590 nm to 1,200 nm. Parameters utilized were a 2.8–3.2 millisecond pulse duration for three pulses with thermal relaxation intervals of 20–30 milliseconds. The 615 nm or 645 nm cutoff filters were utilized based on skin type, with Fitzpatrick types I and II receiving treatment with the 615 nm filter and types III and above with the 645 nm filter. The triple pulses delivered a total fluence of 40–42 J/cm^2. Refrigerated water based gel was applied in a 1–2 mm layer between the crystal and the skin as a heat sink and to promote more uniform light transmission. For the double treatment protocol, only fluence was increased if the response to the first treatment was negative, all other parameters remained the same.

Prior to beginning treatment and at each follow-up visit thereafter photographs and hair

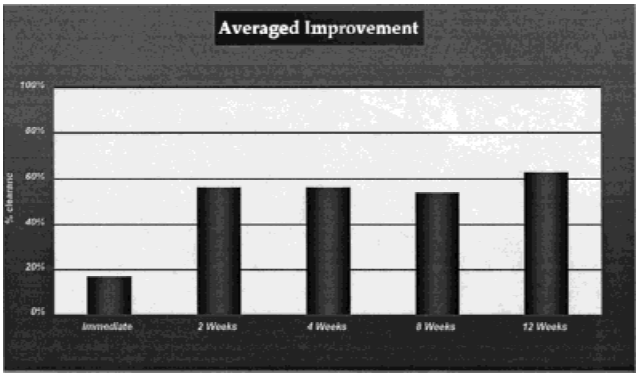

Fig. 1. Single treatment protocol hair clearance by hair count.

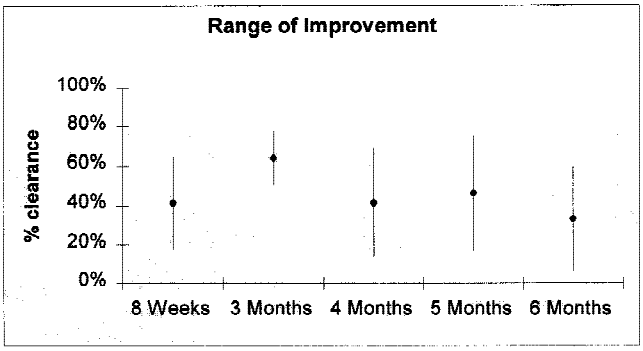

Fig. 2. Double treatment protocol hair clearance by hair count.

counts were obtained by averaging three 1-cm^2 areas on a clear acetate template placed over the skin. Hair counts were manual utilizing 3× magnification. Photographs of original template placement were utilized to realign the template at subsequent visits, although areas treated were large enough that exact placement of the template was not critical. Repeat hair counts and photographs were obtained at 2, 4, 8, and 12 weeks for the single treatment protocol and at additional 4, 5, and 6 months for the double treatment protocol.

RESULTS

For the initial single treatment protocol, very conservative fluences were utilized. At the first visit, immediate post-treatment mean hair clearance of 16% was recorded. At follow-up visits hair counts were performed prior to any treatment. Reduction of hair counts improved to 56% at weeks 2 and 4, 54% at week 8, with a final 63% reduction at 12 weeks (Fig. 1). For the second study, the double treatment protocol, hair clearance of 64% was achieved immediately following the second treatment. The higher figure accounts for the more aggressive parameters utilized after experience with the single treatment protocol. By week 8 reduction of hair counts was 42%. By six months reduction of hair by hair counts was 33%, although many hairs were reduced in diameter (Fig. 2).

It is important to note that hair counts alone may be deceiving. Some patients appeared to be excellent clinical responders even with hair counts reduced only 33%, since many of the hairs were much smaller in hair shaft diameter and therefore much less visible. Excellent responders with darker skin types are shown at three- and six-month follow-up in Figure 3.

Mild erythema following treatment was typical with 92% of patients experiencing this usually for several hours. Urticarial edema around the hair follicles was noted immediately in 72%. Two sites developed a vesicle which healed with no sequelae but led to several weeks of hypopigmentation. Approximately 12% of patients experienced some areas of crusting lasting several days to one week. Resultant hypo- and hyperpigmentation lasting for 4–8 weeks occurred as a result of the crusting but cleared within two months in all cases. Patients who previously underwent electrolysis reported far less pain with IPL.

CONCLUSIONS

The single treatment protocol was utilized initially to test fluence ranges and skin response. These were conservative settings yet allowed reduction of hair counts to approximately 50% during the follow-up period of 12 weeks. The double treatment protocol was initiated with greater fluences and included more darkly pigmented skin types. Most of the crusting side effects were seen in this group.

Examination of the two follow-up periods allows one to conclude that maximal reduction in hair counts from all sites combined is seen between two and three months. (Figs. 2,3) Partial regrowth of hair is observed in our study at the endpoint of six months when averaging all body sites. This is explained by non-synchronous cyclical hair growth with telogen phases lasting six weeks to six months in different body locations [17]. Hair is most susceptible to injury from laser sources during the anagen phase only [12].

Based on our data we conclude that IPL is a safe and effective modality for long-term hair removal. Side effects are minimal with expected se-

Fig. 3. **A:** African-American female (type V) with hair growth on mandible and neck. Moderate pseudofolliculitis barbae due to thick ingrown terminal hairs **B:** Good results at three months with approximately 50% hair reduction after one treatment. Marked reduction of pseudofolliculitis accompanies the hair count reduction and reduction in hair diameter. **C:** Middle Eastern female, para 2, type IV, with heavy beard growth prior to treatment. **D:** Six months post-treatment with 60% hair reduction. Hairs are also much decreased in hair shaft diameter. This patient subsequently had two more treatments with 90% reduction at 1.5 years following initiation of treatment.

quelae of hair follicle damage seen frequently. At six months a 33% reduction in hair growth persists after two treatments. Clinical results probably should be judged not only by hair count but by hair diameter reduction. Conclusions regarding permanency will require data from ongoing two- and three-year follow-up studies with associated histologic examination.

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